WHAT IS CLAIMED IS:

1. A magnetoresistive head comprising:

an antiferromagnetic layer;

a pinned layer formed on the antiferromagnetic layer with a magnetizing direction of the pinned layer being fixed;

a nonmagnetic layer formed on the pinned layer;

a free layer formed on the nonmagnetic layer;

a magnetic domain control film for magnetic domain control of the free layer;

and a pair of electrode films for supplying electric current to a stack of the antiferromagnetic layer, the pinned layer, the nonmagnetic layer, and the free layer;

wherein, when a width of the free layer as viewed from an air bearing surface is defined as a geometrical track width Twr_geo(nm) and expressed as x, a magnetization film thickness product Br•t(G•μm) of the magnetic domain control film and x satisfy the following:

$-2.94 \cdot 10^{-4}x^3 + 8.54 \cdot 10^{-2}x^2 - 5.73x + 116 \leqq Br \cdot t < 3.75 \cdot 10^{-1}x + 130$ and $40 \leqq x < 160$.

2. A magnetoresistive head comprising:

an antiferromagnetic layer;

a pinned layer formed on the antiferromagnetic layer with a magnetizing direction of the pinned layer being fixed;

a nonmagnetic layer formed on the pinned layer;

a free layer formed on the nonmagnetic layer;

a magnetic domain control film for magnetic domain control of the free layer; and

a pair of electrode films for supplying electric current to a stack of the antiferromagnetic layer, the pinned layer, the nonmagnetic layer, and the free layer;

wherein, when a width of the free layer as viewed from an air bearing surface is defined as a geometrical track width Twr_geo (nm) and expressed as x, a magnetization film thickness product Br•t(G•μm) of the magnetic domain control film and x satisfy the following:

$-2.94 \cdot 10^{-4}x^3 + 8.54 \cdot 10^{-2}x^2 - 5.73x + 116 \leqq Br \cdot t \leqq -2.94 \cdot 10^{-4}x^3 + 8.54 \cdot 10^{-2}x^2 - 5.73x + 141$, $Br \cdot t < 3.75 \cdot 10^{-1}x + 130$, and $40 \leqq x < 160$.

3. A magnetoresistive head comprising:

an antiferromagnetic layer;

a pinned layer formed on the antiferromagnetic layer with a magnetizing direction of the pinned layer being fixed;

a nonmagnetic layer formed on the pinned layer;

a free layer formed on the nonmagnetic layer;

a magnetic domain control film for magnetic domain control of the free layer; and

a pair of electrode films for supplying electric current to a stack of the antiferromagnetic layer, the pinned layer, the nonmagnetic layer, and the free layer;

wherein, when a width of the free layer as viewed from an air bearing surface is defined as a geometrical track width Twr_geo(nm) and expressed as x, a magnetization film thickness product Br•t(G•μm) of the magnetic domain control film and x satisfy the following:

$-2.94 \cdot 10^{-4}x^3 + 8.54 \cdot 10^{-2}x^2 - 5.73x + 151 \leqq Br \cdot t < 3.75 \cdot 10^{-1}x + 165$ and $40 \leqq x < 160$.

4. A magnetoresistive head comprising:

an antiferromagnetic layer;

a pinned layer formed on the antiferromagnetic layer with a magnetizing direction of the pinned layer being fixed;

a nonmagnetic layer formed on the pinned layer;

a free layer formed on the nonmagnetic layer;

a magnetic domain control film for magnetic domain control of the free layer; and

a pair of electrode films for supplying electric current to a stack of the antiferromagnetic layer, the pinned layer, the nonmagnetic layer, and the free layer;

wherein, when a width of the free layer as viewed from an air bearing surface is defined as a geometrical track width Twr_geo(nm) and expressed as x, a magnetization film thickness product Br•t(G•μm) of the magnetic domain control film and x satisfy the following:

$-2.94 \cdot 10^{-4}x^3 + 8.54 \cdot 10^{-2}x^2 - 5.73x + 151 \leqq Br \cdot t \leqq -2.94 \cdot 10^{-4}x^3 + 8.54 \cdot 10^{-2}x^2 - 5.73x + 176$, $Br \cdot t < 3.75 \cdot 10^{-1}x + 165$, and $40 \leqq x < 160$.

5. A magnetoresistive head comprising:

an underlying layer;

a free layer formed on the underlying layer;

a magnetic domain control film for magnetic domain control of the free layer;

a nonmagnetic layer formed on the free layer;

a pinned layer formed on the nonmagnetic layer with a magnetizing direction of the pinned layer being fixed;

an antiferromagnetic layer fixing magnetization of the pinned layer; and

a pair of electrode films for supplying electric current to a stack of the underlying layer, the free layer, the nonmagnetic layer, the pinned layer and the antiferromagnetic layer;

wherein, when a width of the free layer as viewed from an air bearing surface is defined as a geometrical track width Twr_geo(nm) and expressed as x, a magnetization film thickness product Br•t(G•μm) of the magnetic domain control film and x satisfy the following:

$-2.94 \cdot 10^{-4}x^3 + 8.54 \cdot 10^{-2}x^2 - 5.73x + 116 \leqq Br \cdot t < 3.75 \cdot 10^{-1}x + 130$ and $40 \leqq x < 160$.

6. A magnetoresistive head comprising:

an underlying layer;

a free layer formed on the underlying layer;

a magnetic domain control film for magnetic domain control of the free layer;

a nonmagnetic layer formed on the free layer;

a pinned layer formed on the nonmagnetic layer with a magnetizing direction of the pinned layer being fixed;

an antiferromagnetic layer fixing magnetization of the pinned layer; and

a pair of electrode films for supplying electric current to a stack of the underlying layer, the free layer, the nonmagnetic layer, the pinned layer and the antiferromagnetic layer;

wherein, when a width of the free layer as viewed from an air bearing surface is defined as a geometrical track width Twr_geo(nm) and expressed as x, a magnetization film thickness product Br•t(G•μm) of the magnetic domain control film and x satisfy the following:

$-2.94 \cdot 10^{-4}x^3 + 8.54 \cdot 10^{-2}x^2 - 5.73x + 116 \leqq Br \cdot t \leqq -2.94 \cdot 10^{-4}x^3 + 8.54 \cdot 10^{-2}x^2 - 5.73x + 141$, $Br \cdot t < 3.75 \cdot 10^{-1}x + 130$, and $40 \leqq x < 160$.

7. A magnetoresistive head comprising:

an underlying layer;

a free layer formed on the underlying layer;

a magnetic domain control film for magnetic domain control of the free layer;

a nonmagnetic layer formed on the free layer;

a pinned layer formed on the nonmagnetic layer with a magnetizing direction of the pinned layer being fixed;

an antiferromagnetic layer fixing magnetization of the pinned layer; and

a pair of electrode films for supplying electric current to a stack of the underlying layer, the free layer, the nonmagnetic layer, the pinned layer and the antiferromagnetic layer;

wherein, when a width of the free layer as viewed from an air bearing surface is defined as a geometrical track width Twr_geo(nm) and expressed as x, a magnetization film thickness product Br•t(G•μm) of the magnetic domain control film and x satisfy the following:

$-2.94 \cdot 10^{-4}x^3 + 8.54 \cdot 10^{-2}x^2 - 5.73x + 151 \leqq Br \cdot t < 3.75 \cdot 10^{-1}x + 165$ and $40 \leqq x < 160$.

8. A magnetoresistive head comprising:

an underlying layer;

a free layer formed on the underlying layer;

a magnetic domain control film for magnetic domain control of the free layer;

a nonmagnetic layer formed on the free layer;

a pinned layer formed on the nonmagnetic layer with a magnetizing direction of the pinned layer being fixed;

an antiferromagnetic layer fixing magnetization of the pinned layer; and

a pair of electrode films for supplying electric current to a stack of the underlying layer, the free layer, the nonmagnetic layer, the pinned layer and the antiferromagnetic layer;

wherein, when a width of the free layer as viewed from an air bearing surface is defined as a geometrical track width Twr_geo(nm) and expressed as x, a magnetization

film thickness product Br•t(G•μm) of the magnetic domain control film and x satisfy the following:

$-2.94 \cdot 10^{-4}x^3 + 8.54 \cdot 10^{-2}x^2 - 5.73x + 151 \leqq Br \cdot t \leqq -2.94 \cdot 10^{-4}x^3 + 8.54 \cdot 10^{-2}x^2 - 5.73x + 176$,

$Br \cdot t < 3.75 \cdot 10^{-1}x + 165$, and $40 \leqq x < 160$.

9. A magnetoresistive head comprising:

an insulative layer formed on a substrate;

an antiferromagnetic layer formed on the insulative layer;

a pinned layer formed on the antiferromagnetic layer with a magnetizing direction of the pinned layer being fixed;

a nonmagnetic layer formed on the pinned layer;

a free layer formed on the nonmagnetic layer;

a pair of electrode films for supplying electric current to a stack of the antiferromagnetic layer, the pinned layer, the nonmagnetic layer and the free layer; and

an electrode underlying film;

wherein the electrode underlying film is formed directly on the insulative film in a case where a width of the free layer as viewed from an air bearing surface is defined as Twr_geo (nm) and expressed as x, and $x < 40$.

10. A magnetoresistive head according to any one of claims 1 to 8, wherein the magnetic domain control film comprises a magnetic film made of a CoPt alloy comprising at least 4 to 30 at% of Pt, or a CoCrPt alloy, or CoCrPt-ZrO_2 or CoCrPt-SiO_2 further comprising 2 to 15 at% of Cr.

11. A magnetoresistive head according to any one of claims 1 to 8, wherein the magnetic domain control film comprises a stacked film in which at least two or more magnetic films are antiferromagnetically coupled by way of a nonmagnetic film comprising Ru, Cr, Ir, Rh, Os, Re, Au, Ag, Cu or an alloy thereof, and a magnetic film as a constituent element thereof is a magnetic film comprising a CoPt alloy comprising at least 4 to 30 at% of Pt, or a CoCrPt alloy, or CoCrPt-ZrO_2 or CoCrPt-SiO_2 further comprising 2 to 15 at% of Cr or a magnetic film having soft magnetic property containing Fe or Ni.

12. A magnetoresistive head according to any one of claims 1 to 8, wherein the magnetic domain control film is a stacked film having two-layers of magnetic films

antiferromagnetically coupled by way of a nonmagnetic film, and the magnetization film thickness product Br•t of the magnetic domain control film is defined as

$$Br \cdot t = Br1 \cdot t1 - Br2 \cdot t2$$

assuming residual magnetic flux densities of the two layers of magnetic layers as Br1 and Br2, respectively, and film thicknesses thereof as t1 and t2, respectively.

13. A magnetoresistive head according to any one of claims 1 to 8, wherein the magnetic domain control film is a stacked film having three layers of magnetic films and antiferromagnetically coupled by way of a nonmagnetic film, and the magnetization film thickness product Br•t of the magnetic domain control film is defined as

$$Br \cdot t = Br1 \cdot t1 - Br2 \cdot t2 + Br3 \cdot t3$$

assuming residual magnetic flux densities of the three magnetic layers as Br1, Br2, and Br3, respectively, and the film thicknesses thereof as t1, t2, and t3, respectively.

14. A magnetic head having a magnetoresistive head according to any one of claims 1 to 8 having as a reading head and having a writing head for in-plane recording.

15. A magnetic head having a magnetoresistive head according to any one of claims 1 to 8 as a reading head and having a writing head for perpendicular recording.